Successful and unsuccessful adhesives for use on neonate flatback turtles (*Natator depressus*): what works and doesn't work on the "Teflon turtles"

Jeanette Wyneken[1], Michael Salmon[1], Mark Hamann[2], Anton Tucker[3], and Scott Whiting[3]

[1]Department of Biological Sciences, Florida Atlantic University, Boca Raton, Florida 33431, USA
[2]College of Marine and Environmental Sciences, James Cook University, Townsville, Queensland 4811, Australia
[3]Department of Parks and Wildlife, Western Australia Department of Parks and Wildlife, Kensington 6151, Western Australia

INTRODUCTION

There are few neonate sea turtle dispersal and habitat selection studies because of the technical challenges associated with tracking small sea turtles. Recently, neonate tagging methods were developed that allow tracking of sea turtles as small as 300g[1,2] . When attaching PTT (satellite) tags or other data collection devices to sea turtles, the methods must be compatible with growth rates, allow normal behavior and must adhere to scutes. Mansfield et al.[1] attached tracking tags to rapidly growing neonate loggerheads (*Caretta caretta*) based upon They developed assays prior to field releases to ensure that these requirements were met while preserving data quality.

Flatback turtles (*Natator depressus*) are difficult to tag because their scutes are thin and "waxy". Few substances adhere to their integument.

GOAL

Our goal was to test and identify adhesives that could be used to attach small solar-powered satellite tags to neonate flatback turtles.

METHODS

Hatchlings were collected in January, 2015, as they emerged from 6 nests at 80 Mile Beach, Western Australia, and 4 nests at Blacks Beach, MacKay, Queensland. Turtles were raised under comparable husbandry conditions (Fig. 1) at the Aquarium of Western Australia, and on the campus of James Cook University, Queensland.

Fig. 1. Flatback husbandry. Turtles were housed individually in baskets, floated in sea water tanks. Basket size increased as the turtles' grew.

Literature Cited

1 Mansfield Mansfield, K.L., Wyneken, J., Rittschof, D., Walsh, M., Lim, C.W. and Richards, P.M., 2012. Satellite tag attachment methods for tracking neonate sea turtles. Marine Ecology Progress Series, 457, pp.181-192.
2 Mansfield, K.L., Wyneken, J., Porter, W.P. and Luo, J., 2014. First satellite tracks of neonate sea turtles redefine the 'lost years' oceanic niche. Proceedings of the Royal Society of London B: Biological Sciences, 281(1781), p.20133039..

ADHESIVES SELECTION & TESTING

Candidate tagging adhesives were from purchased from medical, marine, and cosmetic sources. Criteria were:

- Flexibility when cured
- No exothermic curing reaction
- Minimal curing time
- Manufacturer's specification of water tolerance
- Compatibility with skin and tag epoxy
- Low risk of toxicity

Criteria used to accept adhesives included:

- maximize retention
- accommodate normal growth
- allow normal behaviour: swimming, feeding maneuvering, and posture
- no evidence for irritation or abrasion effects
- sloughs cleanly

Candidate adhesives were applied to the turtles' when they reached ≥75 g. (Fig 2).

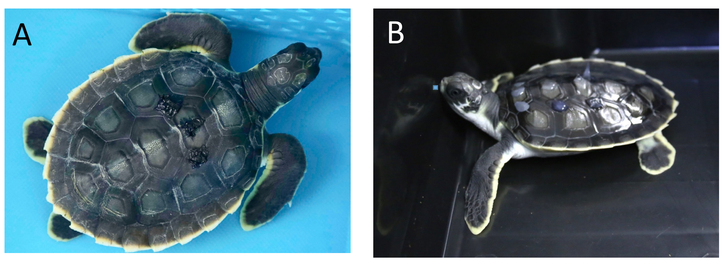

Fig. 2. Flatbacks with adhesives curing in the lab. A. Testing SikaFlex29i on vertebral 2. **B.** Testing four different candidate adhesives simultaneously. Each vertebral scute has a different adhesive,.

Preparation: Turtles were washed in fresh water. Scutes were buffed smooth using a Magic Eraser™. Three drops of adhesive were applied on a single vertebral scute with up to 4candidat glues tested per turtle (Fig 2). Each vertebral scute provided 3 surface preparation options:

- **Left side of each vertebral was cleaned with a solvent (SkinPrep™, 70% ethanol, 70% isopropanol, or povidone iodine followed by isopropanol).**
- **Midline retained the textured remnant of the initial hatchling scute; freshwater rinsed & air dried.**
- **Right side was cleaned with freshwater and air dried**

Glue was applied as single drops and allowed to air dry for up to 4 h. If the glue remained tacky, the turtle was returned to water and curing completed in the water. Glue loss/persistence was quantified at least weekly.

RESULTS & DISCUSSION

Several adhesives were rejected immediately because they failed to cure or stick to flatback scutes. These were:

- Acrylic emulsions: Pros Aide 2,
- Gum Mastic: Mastisol
- Silicone: BT-460 Secure Medical Adhesive
- Cyanoacrylate: Extreme16

Adhesives that did adhere and were tested include:

- Cyanoacrylates: PermaRite 4, VetBond
- Silicones: Dow Corning RTV3140, Aqueon Silicone
- Polyurethanes: SikaFlex291, Sika SuperGrip, FixTech190, 3M5200

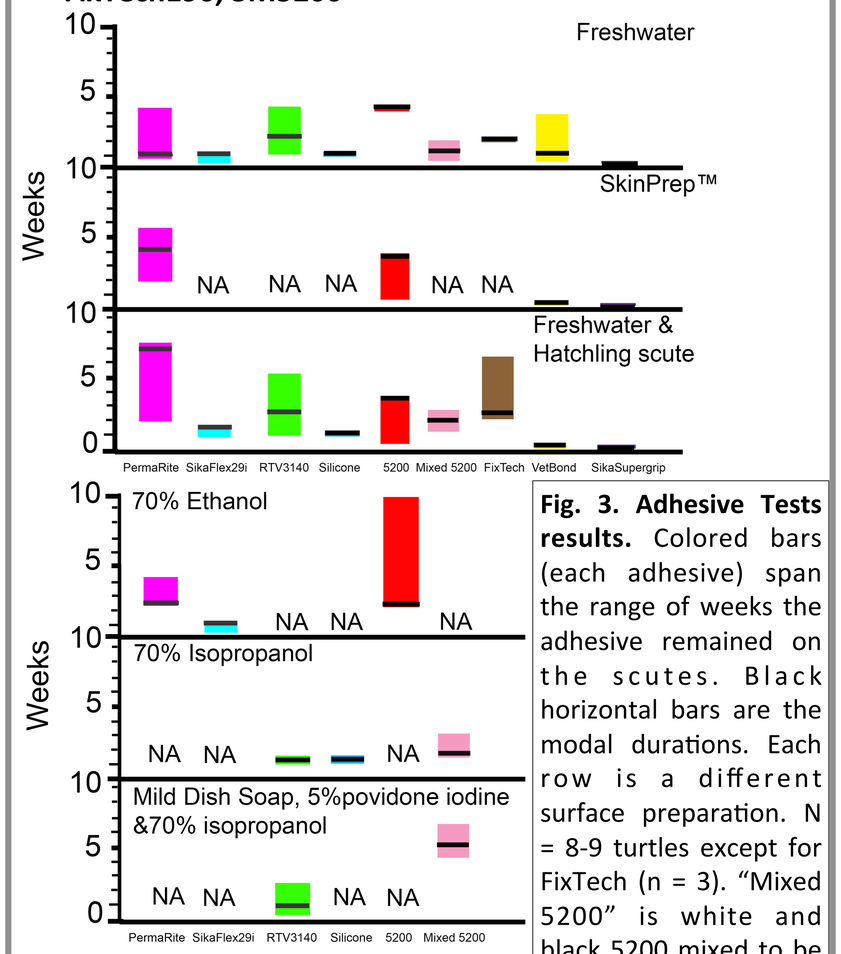

Fig. 3. Adhesive Tests results. Colored bars (each adhesive) span the range of weeks the adhesive remained on the scutes. Black horizontal bars are the modal durations. Each row is a different surface preparation. N = 8-9 turtles except for FixTech (n = 3). "Mixed 5200" is white and black 5200 mixed to be gray.

There was considerable variation in adhesive duration. PermaRite and 3M5200, when attached to the hatchling scute remnant or with SkinPrep cleaning tended to persist the longest. Cleaning with alcohols did not increase duration. Some clutches produced turtles that shed adhesives quickly, regardless of preparation.

ACKNOWLEGMENTS

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FAU FLORIDA ATLANTIC UNIVERSITY

Department of Parks and Wildlife

JAMES COOK UNIVERSITY AUSTRALIA